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## CONDITIONS GOVERNING THE DISTRIBUTION OF INSECTS IN THE FREE ATMOSPHERE*


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### PART II: SURFACE AND UPPER WINDS

The atmosphere as a distribution medium for insects has been the subject of extensive investigations, through trapping by kite and by aircraft. It has been found that insects are present at heights in excess of four kilometers, where the temperature is at freezing or below.

On the basis of its insect population, the atmosphere has been divided into a so-called "terrestrial" zone, generally supposed to extend to about 60 meters above the surface, and a "plankton" zone above this (1). Within this plankton zone, the insect population is supposed to consist chiefly of weak fliers or smaller flightless insects borne upon air currents. There seems to be some difference of opinion between the American and European schools as to the relative importance of horizontal and vertical currents as means of distribution to the plankton zone, but both schools seem agreed that the strong upper winds are important in long-distance distribution through this zone.

It is generally conceded that the winds of the lower layers of the atmosphere are of the utmost importance in the horizontal transport of insects between surface localities. A wealth of observational evidence exists in proof of this (6). In the following discussion, the horizontal distributive powers of the wind in the lower layers (to about 0.5 km.) will be neglected, since they are so well-known. The chief concern of this work is a consideration of the lower winds as means of carrying the insects to higher altitudes, and the efficiency of the stronger upper winds as agents of insect transport vertically and horizontally through the plankton zone.

Despite observational evidence to the contrary, the belief persists that the horizontal distributive powers of the lower winds may be applied directly to the winds in the upper air. Indeed, the assumption seems a logical one, at first, since the wind speed generally increases with height in the free air, and it seems natural that, if a wind of 7 m. per sec. (15.7 mi. per hr.) at the surface will transport an insect 200 km., then a wind of 14 m. per sec. at 4 km. should transport the same insect at least twice 200 km. In addition to this, the literature contains assertions that high wind speeds may carry insects upward. Such reasoning overlooks one important point: the contribution upon the part of the insect, if not physically, then aerodynamically.

Glick (5) states that its size, weight and relative buoyancy directly determine the height to which an insect may be carried. He cites the formula $A_C = K\frac{r}{w}$, where $A_C$ is the aerostatic, or "lighter than air" coefficient of the insect, when $r$ is the area in metric units, $w$ is the weight in milligrams, and K is a constant. From this it will be seen that, the greater the area per unit mass exposed perpendicular to the force of gravity, the greater the buoyancy. The only limitation imposed upon this formula in the physical sense, is that, since an insect is heavier than air, if it is incapable of supporting itself, or is not supported by some means, it has to come down to earth regardless of what its "buoyancy" may be.

The present writer has no quarrel with the broad statement that wind is an important factor in insect distribution. However, he holds with Berland

*This paper is the second of a series appearing in succeeding numbers of the *Canadian Entomologist.*

(1) that the plankton zone is populated by *vertical* currents, particularly at levels where the temperature is below the minimum flight temperatures of the winged transients. Therefore, the writer proposes, on the basis of the results of certain simple experiments and upon the analysis of published data, that the wind at higher levels be considered a horizontal distribution factor only if the temperature of the level is such that an insect there deposited is active enough to maintain altitude. In other words, no matter how weak its flight powers may be, the insect must still be capable of adopting a flight attitude, even though it cannot break free of the air current. If the insect is largely inactivated or inert, or if it is wingless and is lacking silken strands, evidence mounts that the horizontal wind must be discounted as a transportation agent, either horizontally or vertically, in the absence of vertical currents.

Wind may be defined as the flow of air from one atmospheric region to another. This horizontal motion of the air is fundamentally of a streamline nature. At the surface of the earth, particularly over multitextured land surfaces, inequalities of the surface impart "eddy", or turbulent motion to these streamlines. An eddy is apparently of complex structure, but it is known that vertical components are produced by the imposition of turbulence upon an air stream. The greater the wind speed and the rougher the ground, the more extensive are these vertical components. Thus, over mountainous regions, the turbulent, or friction layer, may reach to 1.5 km. The wind at higher levels generally retains its streamline characteristics, unless disturbed by far-reaching air-mass phenomena. Thus, it may be assumed that, within a given air mass, the upper winds, in themselves, lack a vertical component.

In Part I of this work, it was found that decreasing temperature caused insects to be less and less capable of co-ordinated movement. It further developed that a consistent reaction to the thermal point of minimum flight activity was a folding of the wings in the natural rest position, no matter how quickly the drop in temperature occurred. It is obvious that an insect with folded wings presents much less area per unit to an air stream. In order to determine the relative importance of the vertical and horizontal components of wind velocity in buoying up a given insect, the following simple experiments were performed.

It was assumed that an insect was transported to the region of the zero isotherm and became frozen and inert (since the average decrease of air temperature with height is 6.0 degrees Centigrade per km., this places the zero isotherm at a height varying between 3-4.5 km. under summer conditions in temperate North America). It was necessary to determine, for a given insect, the minimum horizontal air speed necessary to put it in motion, and the minimum vertical air speed necessary to counteract the force of gravity.

Dead, dried insects were used. It was reasoned that, the less the mass per unit area, the less would be the force necessary to move the body horizontally or to support it vertically. Theoretically, this gave the horizontal force a considerable advantage over the vertical force. The experimental procedure was as follows.

Various insects were selected both from the typical smaller strong fliers of the terrestrial zone and from small insects with weak flight-power, which make up the population of the plankton zone. A variety of Homoptera, Neuroptera, Coleoptera, Lepidoptera, nematoceran and muscoid Diptera and parasitic Hymenoptera were used. Only insects up to about 25 mg. dry weight were used, which limited the largest size to that of a 12 mm. elaterid beetle, or a moderate-sized sarcophagid fly. The wing expanses of these insects were classified as "folded", "half-extended", or "fully extended". Each insect species was represented by each of these wing-types.

The minimum force necessary to put the insect body in horizontal motion was determined in two ways. In the first instance, the insect was placed in a glass tube, which was open at both ends. Then the air stream velocity was so

adjusted as to start the insect body moving. Readings of the speed of the air stream, at the position of the insect, were taken with the aid of a windmill anemometer.

To check the effect of frictional errors arising from such a procedure, a makeshift wind tunnel was devised, using an 18-inch fan. At a given distance from the fan, the insect body was suspended upon a short length of fine hair. The air speed necessary to start it moving horizontally was determined as before.

It will be seen that in both of the above experiments, any values determined for the horizontal component would be consistently too high. This fact must be taken into consideration when the data are examined.

In order to determine the minimum force necessary to support the insect body against gravity, the insect was again placed in the open-ended glass tube, pointed vertically. The insect body rested on wire gauze at the lower end of the tube at a fixed distance from the air source. The minimum vertical current necessary to support the body without a continued rise was then determined with

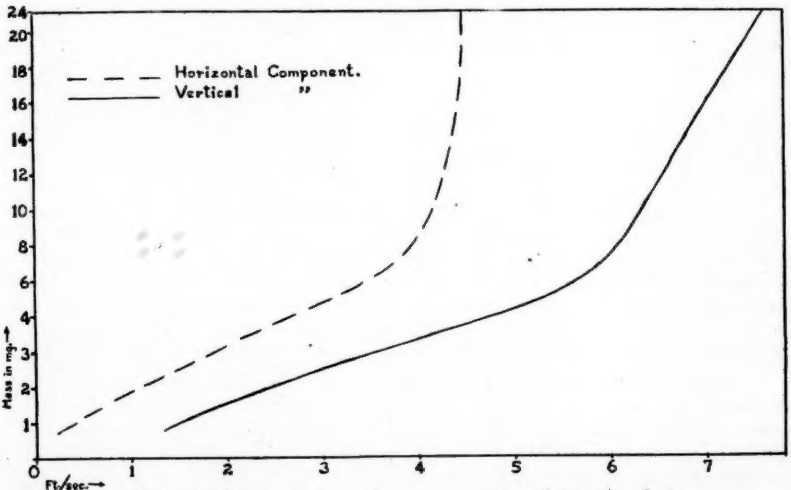


Figure 2.— Air velocities necessary to move or support insects of given mass.

the aid of the windmill anemometer. To check the effect of friction, which would be much smaller in this case, or to damp out any turbulence over the gauze, the same work was done using a hair-suspension in the open air.

If a body is dropped from rest, through air, it accelerates under gravity until the drag, or resistance to motion becomes equal to the weight of the object. The velocity then becomes constant, and is known as the terminal velocity. It is evident that the drag will be determined to a large extent by the size and shape of the surface of the object exposed perpendicular to the direction of motion, and by the density of the air. In the present work, it was found that the most convenient method of expressing the results graphically was to plot mass in mg. against air speed in feet per second for both the horizontal and vertical velocity components. The results for insects with folded wings are given in figure 2.

An examination of the mass-velocity curve for the horizontal component shows that the horizontal velocity necessary to move an insect increases rapidly with mass up to about 7 mg. Thereafter, it becomes quite constant up to at

least 25 mg. It is probable that the part of this curve below 4.5-5.0 mg. is affected by the reaction of extremely light-bodied insects to slight vertical eddies in the course of the experiment. If these eddies could be damped out, the lower part of the curve would perhaps be steeper.

The vertical velocity component, it will be noticed, has a consistently higher value per mg. of mass, which is to be expected. It is evident that this curve does not become constant within the experimental range, but increases steadily.

The assumption which may be drawn from these curves is, that, although it may require little horizontal force to move a given, inert insect body in the horizontal plane, unless a certain vertical force is present to support it in the free air, the body will fall, presumably at a terminal velocity equal to the force necessary to sustain it. This velocity will be greater at higher altitudes where the density and the viscosity of the air is less (2).

To check the accuracy of these curves, several insects of varying sizes and shapes were selected, and the horizontal and vertical velocity components were determined as previously described. Then the mass was estimated by an inspection of the two curves. The insect was then weighed and the two mass-values compared. Within the limits mentioned below, the curves hold for such a procedure.

For example, it was found that a sarcophagid fly, with folded wings, required a horizontal velocity of 4.3 ft/sec. to put it in motion, and a vertical velocity of 6.7 ft/sec. to support it. Estimating the dry weight from the curve as plotted gives a value somewhere between 12-13 mg. The actual dry weight was 12.5 mg.

This method breaks down for insects with wings partly or fully extended if the insects are above mosquito size. Neither will it hold for insects with a very large folded-wing-area in proportion to the body, particularly if the wings are folded roof-like as in the Neuroptera. With insects over mosquito size and of average wing-area, partly extended wings throw the points ½ to 1 ft/sec. to the left (i.e., to a smaller velocity), particularly for the vertical component. With the wings fully extended, the points move 2 ft/sec. or more to the left.

If the insects are smaller than the average culicine mosquito, the relative wing area does not seem to be of so much importance. This general rule holds more and more the smaller the insect is. From tests, and check points on the curves, it seems that the more minute insects require vertical currents of the same magnitude whether the wings are extended or folded.

It is evident from the above, that, in the case of the larger light-bodied insects, the wing area is the deciding factor in the rate of fall. The significance of this is that, if such an insect is cooled below its minimum flight temperature, and folds its wings, as it invariably does, it will begin to fall, unless a vertical current of a definite magnitude continues to support it. The insect will fall, no matter what the speed of the horizontal wind.

If the insect possesses an average wing area, it will fall fairly rapidly. Insects with very large wing areas will fall at a slower rate than those with average areas, but they are certainly not immune to gravitational forces. A live chrysopid was dropped into an air stream one foot above the floor. The insect was blown 6+ meters (20 feet) before it escaped from the current. When it was killed and dropped into the same current from the same elevation, it travelled 2.5 metres (8.2 feet) before reaching the floor.

It is of particular interest to note that the smaller insects, which make up the bulk of the aerial plankton population, do not seem to possess enough overall area for their extended wings to produce any appreciable extra drag when the insects themselves are inert. Admittedly the vertical currents necessary to support them are small, but they are at least twice the magnitude of the horizontal currents necessary to move the insects. Any entomologist who has

dropped freshly collected parasitic Hymenoptera in a sandy area in a high wind knows that the specimens reach the earth quickly and but a short distance away.

In applying these results to actual atmospheric conditions, it is well to remember the following circumstances. The insects, being alive, are heavier, and require greater velocities. In addition, the speed of the upper winds usually increases with height, so that an insect falling freely, and being blown by the wind at the same time, will usually have its angle of fall changing, more nearly approaching the vertical as the insect falls into lower regions and decreasing wind speeds. Since the direction of the wind changes with height, it is quite possible for an insect to end up within a short distance of its surface starting point.

It seems certain that the colder portions of the plankton zone are populated by vertical currents alone. An examination of the records of aerial distribution as determined by Glick (5) bears out this contention, even though that author, (p. 112) states:

"At the high altitudes of 6000-16000 feet many insects were taken when the upper-air wind velocities were as high as 45 m.p.h. The velocities at these high altitudes are significant, for when insects reach heights beyond 6000 feet, they are carried upward and doubtless great distances by the usually high winds."

There is nothing in the normal structure of an upper wind (i.e., lacking turbulent eddy components) to indicate the carriage of an insect upward. The simple experiments just described, when coupled with the fact that insects cooled below minimum flight temperatures fold their wings, indicate the need for vertical currents in regions of low temperature. Glick includes upper air data which do not bear out his own statement. His Table 12 gives an example of the effect of vertical currents as opposed to horizontal currents within a zone of low temperature.

The first portion of the table gives the upper air conditions for the morning of March 11, 1931. The most obvious point is the presence of a thick isothermal layer in the air. From 200 ft. 1000 ft. the air temperature drops 5 degrees to a temperature of 52 degrees Fahrenheit. In the next 2000 feet, the temperature drops only one degree more. The wind near the surface is 9 m.p.h., increasing to 15 m.p.h. at 2000 ft. and to 22 m.p.h. at 5000 ft. The air is classified as "slightly rough" up to about 2000 ft., where it becomes "smooth" and remains so thereafter. Four insects were taken at 200 ft. and one at 1000 ft. No insects were taken above 1000 ft.

Meteorologically, the air shows the following characteristics. The surface wind and the winds in the lower layers were strong enough to produce turbulence and vertical eddies through friction with the ground (viz., air "slightly rough"). It is common to have a "temperature inversion" (i.e., temperature increasing with height) form between the turbulent zone and the upper air. The isothermal layer in the present example is one stage in the formation of such an inversion. Such a temperature layer effectively damps out the penetration of any vertical eddies from below, so that the air above is "smooth", even though the wind speed increases with height.

From the point of view of insect distribution, if the surface wind speed was high enough to get the insects off the ground to an altitude of 1000 ft., it would seem reasonable to suppose that the increasing wind speeds above would be sufficient to lift the insects higher. This does not seem to have occurred.

The temperature is 52 degrees at 1,000 feet., becoming isothermal for some distance above this level. This is a fairly low temperature for the flight of diurnal insects, as was shown in Part I. It would seem likely that any diurnal insect tossed up into the smooth layer by the penetrating inertia of a vertical current would be close to its minimum flight temperature, if not below it, and

so cease active flight. An examination of the table shows that there were no insects present except in the region of turbulent motion. Hence, it must be assumed that the vertical axes of the turbulent motion were responsible for any vertical distribution at all. The absence of vertical motion in the smooth, cool air would allow the inactive insects to drop back into a zone where the rough air would sustain them.

The second portion of the table gives data for the morning of August 13, 1931. There is no turbulent zone present. Indeed, the air is classified as "smooth" all the way to 16,100 ft. The wind speeds are consistently lower throughout, the wind near the surface being only 5 m.p.h. and that at 15,000 ft. being 21 m.p.h. Four insects were collected at 1000 ft., where the temperature was 71 degrees, and one insect was collected at each level of 6,000, 8,000 and 10,000 ft., where the temperatures were 54, 53 and 47 degrees respectively.

This particular day offers two possibilities to the analyst from the standpoint of insect distribution. The lower winds were light, and it is quite possible that small convective currents were present which were strong enough to lift an insect but which were not strong enough to affect the flight of the aircraft, hence the "smooth" air classification. It is well-known among glider pilots that the variometer, an instrument measuring rates of ascent, will often show the presence of ascending currents which are too light or too broken up to lift a glider, or even to be felt as "rough" air. Certain plankton-zone insects could easily be lifted up by such currents.

The species of insects taken are not given in the table, but the time of flight (0800-1000 hrs.) would indicate that the insects at higher altitudes might have been normally nocturnal insects, if the presence of convection is ruled out (the high temperatures in the lower layers would permit flight activity of any insects present there). In Part I it was shown that many nocturnal fliers have lower minimum flight temperatures than have most diurnal fliers. Hence, these insects could maintain flight at higher levels. This could account for the presence of one insect at 10,000 feet where the temperature was 47 degrees. At a temperature of 39 degrees at 12,000 ft., no insects were taken.

If there is any argument that a minute insect, rendered inert by low temperature, might be transported long distances at high altitudes by swift upper winds, even if the insect was falling slowly in the absence of supporting vertical currents, it would be well to quote Glick once more. This quotation serves as direct supporting evidence to the contention that, at high, cold levels, there is no lengthy horizontal transport in the absence of convection, and that the insect population is reduced to zero at these levels if convection subsides.

Glick states, in his account of collections over Mexico (p. 139): ". . . convection began . . . the air becoming turbulent. The insects found close to the ground were carried upward, showing a great increase in the upper air at altitudes of 500 feet and above. Convection was decidedly strong during the morning hours, and made flying difficult and hazardous at very low altitudes. In the afternoon, convection was not so strong . . . the numbers of insects decreasing rapidly, especially at the higher altitudes. At sundown there were almost no insects at the high altitudes . . . These changes in the population of the upper air were presented day after day with remarkable regularity."

If the winds at high altitudes are capable of carrying insects great distances, it is difficult to see why the dying out of thermal convection at the ground had the effect of depopulating the higher altitudes. Convective processes persist for a short time in the higher atmosphere after surface heating has ceased, which would account for the few, if any insects taken around sundown.

On the basis of horizontal transport by swift upper winds, it would seem correct to suppose that the upper air over a given area would be filled with minute insects transported there from distant places. Since such is evidently not the case, and since the upper winds do not die out at sundown, it can only

be concluded that something more than a high wind speed is required for lengthy horizontal transport. In the absence of vertical currents, it is likely that this additional factor is a temperature high enough to permit some stance of active flight on the part of a winged insect. Wingless forms (with the exception of spiders) are dependent upon vertical currents alone.

There have been some attempts to correlate the speed of the surface wind with the aerial distribution of insects. Any such attempt should include a subdivision of wind speeds into low speeds permitting convection at the ground, and higher wind speeds which disrupt ground thermals but which replace them with turbulence througout the friction layer. Convective processes permit the greatest vertical distribution in the plankton zone, while a turbulent friction zone is the best possible condition for long-distance horizontal transport. If there are high winds at the ground, and insects are still found high above the friction layer, it is an indication that the wind turbulence has released convective processes inherent in the layer of air at and above the top of the original turbulence zone. This air-mass state often exists under summer conditions.

Strong surface winds are responsible for populating the lower levels (and, indirectly, through upper convection, the upper levels) with many insects, particularly wingless forms and larvae. However, it is the *vertical* component in a sudden gust which lifts an ant or a collembolan from a tree-top leaf and turns them airborne. The transport of very hairy, small caterpillars is simply a microscopic version of the eddy transport of a feather. Some idea of the chances of the eddy transport of hairy caterpillars from a centre of infestation may be gained by observation upon the varying and devious paths taken by wind-blown leaves dropping from a given area of a single branch. This phenomenon serves also as an illustration of the relative efficiency of horizontal and vertical currents in keeping an inert object airborne.

The movement of caterpillars upon silken strands (3), or the tremendous journeys of spiderlings at high altitudes (4) must not be confused with the ordinary transport of winged or wingless insects. A lengthy silk strand provides a most efficient type of free balloon, particularly in the case of a spiderling. Such forms are equally dependent upon horizontal or vertical currents, regardless of the air temperature.

It is well to watch for other factors when attempting to correlate surface wind speeds with the aerial activity of insects. For instance, Glick (5) found that Diptera reacted favorably to moderate increases in wind speed. It seems certain that Diptera, particularly, increase their activity in regions of slightly lowered atmospheric pressure, as was shown in Part I. A deepening low pressure area on the weather map is indicated by increased surface winds blowing around the area. It is quite possible that the increased aerial population of the Diptera stemmed originally from a barotaxic reaction rather than from any anemotaxis.

In summation, the writer believes that ascending currents are necessary to produce or maintain the plankton population of the atmosphere at air temperatures below about +7.0 degrees C., or, during the summer air conditions of temperate North America, at corresponding altitudes above 2-2.5 km. Accordingly, he would suggest that some distinction be made between the levels of the insect plankton zone, as determined by the effect of air temperature upon the relative ability of the insects to remain active, and hence, airborne. For instance, the lower levels of the zone, at temperatures above +7.0 degrees C., might be termed the "active" plankton zone. This portion would include the vast majority of the aerial insect population, and would embrace all individuals which might be liable to extensive horizontal distribution by winds. Winged forms would be capable of maintaining a flight attitude in this temperature zone, and could be borne great distances. Wingless forms in this zone would still be dependent upon the presence of turbulence for maintenance of altitude, and hence, for any lengthy horizontal transport by the wind. The upper levels, at temperatures below +7.0 degrees C., might be termed the "inert" plankton

zone. The majority of insects within this region would be dependent solely upon vertical, rather than horizontal air currents, and, with the exception of spiderlings, would not be liable to any extensive horizontal distribution, regardless of the wind velocity. Since both strong winds (with attendant turbulence) and convection are normally diurnal phenomena, the greatest population density in the atmosphere would occur, under normal conditions, during the hours of daylight.

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# NEW GENERA AND SPECIES OF NORTH AMERICAN TACHINIDAE (DIPTERA) *

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The new genera and species described below are based upon material collected largely in the western United States and Canada. The types represented by Canadian material, which was loaned for study through the courtesy of A. R. Brooks, are returned to the National Collection at Ottawa. Unless otherwise specified under the descriptions, the remainder of the type specimens are in my collection.

## **Myioclonia** n. gen.

Similar to *Grisdalemyia,* but the epistoma distinctly narrowed; first abdominal segment without discals; antennae shorter and calypters much smaller.

Female only. — Head as wide as high, frontal profile hardly sloped, nearly one-third longer than concave facial; antennal axis well below eye middle and about one-fourth longer than oral, latter far above lower edge of head; face moderately impressed, its ridges practically bare; epistoma well narrowed from clypeus and slightly bowed forward from plane of same; vibrissae on oral margin, barely meeting to decussate at tips; front at vertex about one-fourth head width, gradually widened downward to antennae; frontals rather strong, one or two bristles beneath antennal base; one large proclinate orbital; ocellars strong, proclinate; inner verticals erect, convergent to decussate at tips, outer pair smaller, divergent; antennae hardly two-thirds length of face, first segment short, second and third sub-equal in length; arista short, thickened at extreme base, micropubescent, middle segment short; parafacial bare, narrowed below to about

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one-third clypeal width; cheek two-thirds eye height, coarsely bristled below middle; eye oblique, sparsely pilose, not quite reaching vibrissal level; proboscis short, stout, labella large; palpi longer than antennae, barely thickened at tip; back of head convex and considerably bulged at side below middle. Thoracic chaetotaxy: acrostichal 1, 2; dorsocentral 2, 3; intraalar 3; supraalar 3; presutural 1 (outer); notopleural 2; posthumeral 1; humeral 3; postalar 2; pteropleural 1 (smaller than sternopleural); hypopleural 4-5; sternopleural 1, 1; scutellum with 2 lateral, 1 strong decussate apical and 1 weak discal pair; prosternum and propleura bare; infrascutellum normally developed; sides of postnotum beneath calypters bare; latter small, with roundish hind lobes hardly exceeding twice size of anterior ones. Abdomen convex, slightly longer and wider than thorax, anal segment pointed; first segment with one pair of long median marginals, second and third with a complete marginal row besides one median and one or more lateral discals on each; fourth segment strongly bristled on entire upper surface except basal margin; sternites exposed. Wings long, extending well beyond tip of abdomen; first vein bare, third with one or two bristly hairs near base; first posterior cell narrowly open to closed at costa near extreme wing tip; last section of fifth vein short; hind cross vein slightly nearer bend of fourth than small cross vein; costal spine strong.

Genotype: *Myioclonia erythrocera* n. sp.

## **Myioclonia erythrocera** n. sp.

*Female.* Front at vertex 0.26 and 0.27 of head width in the two specimens, widening to 0.40 of same at antennal base; head with subshiny gray pollen on blackish ground color tinged with red on cheek grooves and vibrissal angles; frontal vitta deep brownish to black, slightly narrower than parafrontal; antennae wholly orange red, arista blackish on thickened base, thence paler to tip; palpi yellow; back of head thinly gray pollinose and sparsely clothed with short black hairs.

Thorax and scutellum black, subshining with uniform thin gray pollen visible in most views becoming heavier on anterior margin including humeri, notum not vittate; calypters yellow.

Abdomen shiny black, but showing an even whitish bloom when viewed at a flat angle; genitalia retracted within a slitlike caudoventral orifice.

Legs black, moderately long but stoutish; hind tibiae not ciliated, preceding pair with two long and one small bristles near middle on outer front side; claws and pulvilli shorter than apical tarsal segment.

Wings tinged with yellow near base, becoming grayish hyaline apically and towards posterior margin; bend of fourth vein obtuse, without stump or fold and close to hind margin of wing; epaulets reddish yellow.

Length, 6.5 – 7.5 mm.

*Holotype*: female, labeled "Smoky Mountains, Tenn., June, 1933", *Paratype*: female, Simcoe, Ont., June 13, 1939 (G. E. Shewell) in the Canadian National Collection.

## **Myioclonia albertana** n. sp.

*Female.* Differs from *M. erythrocera* mainly as follows: Front slightly wider, at vertex 0.31 of head width; third antennal segment and cheeks wholly black; parafacial three-fourths clypeal width; abdomen about as wide as thorax and one-fourth longer than same; wings paler yellow near base and calypters white with a faint tawny tinge.

Length, 7.5 mm.

*Holotype*: female, Lethbridge, Alberta, June 6, 1923 (H. E. Gray), and 1 female *paratype*, same data, in the Canadian National Collection.

## **Myioclonia nigricornis** n. sp.

*Female*: Smaller and somewhat narrower in build than the two preceding species, from which it is readily distinguished by the wholly black antennae and palpi. In other characters very similar to *M. albertana,* except the calypters are more distinctly yellow and the epaulets are black.

Length, 6 mm.

*Holotype*: female, Electron, Washington, June 2, 1933 (J. Wilcox).

## **Lixophaga opaca** n. sp.

Differs from the known related species in having the abdomen above wholly covered with heavy opaque patternless pollen.

*Male*. Front at vertex 0.25 of head width, diverging moderately below middle; parafrontal gray, subequal width of blackish median vitta; frontal row descending to apex of second antennal segment, upper two or three bristles reclinate; no orbitals; outer verticals vestigial; ocellars proclinate; antennae black, reaching nearly to oral margin, third segment broader than parafacial, about four times longer than second; arista long, slender beyond thickened basal fifth, micro-pubescent; face moderately impressed, its ridges haired to weakly bristled on basal fourth to third; vibrissae on oral margin; cheek nearly one-fourth eye height; palpi yellow; proboscis short.

Thorax and scutellum black, gray pollinose, notum with well defined vittae. Chaetotaxy: acrostichal and dorsocentral 3, 3; intraalar and supraalar 3; intrapostalar well developed; pteropleural small; sternopleural 2, 1; scutellum with 3 lateral, 1 decussate apical (small or hairlike) and 1 discal pair; prosternum setose; propleura bare; sides of postnotum beneath calypters normally bare, hind lobes of latter tawny.

Abdomen black with sides reddish but this color largely obscured by thick grayish pollen which becomes somewhat thinner on venter; segments one and two bearing a pair of median marginal bristles, three and four each with a marginal row besides a discal row on last and a stoutish discal pair on segments two and three; genital segments blackish, retracted; forceps moderately elongate, slender, with inner pair slightly keeled at base behind, divided and divergent apically; sternites largely covered.

Legs black; claws and pulvilli exceeding length of apical tarsal segment; mid tibiae with one bristle on outer front side near middle, hind pair not ciliate.

Wings hyaline with a slight uniform grayish tinge; first posterior cell narrowly open a little before exact wing tip; bend of fourth vein obtuse, without stump or fold; third vein with two or three hairs near base; costal spine small.

*Female*. Front at vertex 0.30 of head width, widening gradually downward to antennal base; two proclinate orbitals; outer verticals moderately long; abdomen broader and wholly black in ground color; otherwise as in male.

Length, 7–8 mm.

*Holotype*: male, Blewett, Washington, June 18, 1933 (J. Wilcox). *Allotype*: female, Yakima, Washington, August 19, 1926, no collector's label. *Paratypes,* 3 males in the Canadian National Collection as follows: Edmonton, Alberta, July 1, 1923 (E. H. Strickland) and Waterton, Alberta, July 10, 1923 (H. L. Seamans).

## **Myiopharus securis** n. sp.

Differs from *M.* (*Exorista*) *dorsalis* Coq. (*Parkeriellus flavipalpis* Sm.) in having the scutellum reddish on apical margin; parafacial in male three-fourths clypeal width, and last three abdominal segments almost entirely pollinose above.

*Male.* Front at vertex 0.26 of head width, hardly widening to near middle thence rather rapidly so to antennal base; parafrontal blackish on upper half, silvery downward and concolorous with parafacial; frontal vitta deep reddish brown, much narrower than parafrontal; frontals in a single row, diverging beneath antennal base and descending nearly to apex of second segment, upper two bristles stout, reclinate; outer verticals vestigial, inner ones strong and nearly erect; two proclinate orbitals; ocellars rather weak, proclinate; antennae black, nearly as long as face, third segment slender, about two and one-half times second; arista short, micro-pubescent, thickened on basal two-fifths, basal segments short; face well impressed, gray pollinose on black ground color, ridges divergent below, bristled on lower half; parafacial bare, hardly at all narrowed downward and fully three-fourths clypeal width; vibrissae on oral margin, moderately long, decussate; cheek black with strong reddish tinge, thinly pollinose, nearly one-third eye height; eyes pilose; proboscis short, stout; palpi yellow, slightly thickened apically; back of head black, with sparse pale hairs surrounding neck but the outer margin wholly black-haired.

Thorax black, notum subshining, with thin brownish gray pollen which shows four very indistinct dark vittae in a flat rear view; pleura subshining black, scutellum with denser changeable gray pollen. Chaetotaxy: acrostichal 3, 3; dorsocentral 3, 3; intraalar 3; supraalar 3; postalar 2; presutural 1 (outer); notopleural 2; posthumeral 2; humeral 3; pteropleural 1 (not large); sternopleural 2, 1; scutellum with 3 lateral, 1 small decussate apical and a somewhat larger discal pair; propleura bare; prosternum setose; sides of postnotum beneath calypters bare, hind lobes of latter opaque, white.

Abdomen ovate, black with changeable or tessellated gray pollen above showing a vague median dark stripe in most views; hairs on upper surface erect; basal segments each with a pair of median marginals besides a pair of discals on second; third segment also with a pair of discals and a marginal row; fourth bristled on entire upper surface beyond basal margin, the bristles erect but somewhat smaller than on preceding segment; genitalia black, small, retracted.

Legs black; claws and pulvilli short; mid tibia with one long bristle on outer front side near middle; hind tibia with a row of rather widely spaced bristles of fairly uniform length on outer posterior side with one near middle considerably longer and stouter.

Wings subhyaline; first posterior cell narrowly open well before extreme wing tip; third vein with two or three hairs near base; bend of fourth vein obtuse, without stump or fold; hind cross vein bicurved, oblique to fourth which it joins nearer bend than small cross vein; costal spine small.

*Female.* Grayer in general aspect than male; front at vertex 0.25 of head width, widening uniformly downward to antennae; outer verticals developed; parafacial gradually narrowed downward; facial ridges bristled on less than lower half; abdomen in profile arched above and concave ventrally, apex broadly truncate; genitalia terminating in a very thin shiny bladelike organ, which in profile is slightly bowed, fully half as wide as long and with apex broadly rounded; mesosternum bearing two large dense clusters of coarse blunt-tipped spines recurved over middle coxae.

Length, 6 - 6.5 mm.

*Holotype*: male, "Austin, Texas, May 16, 1927". *Allotype*: female, Taylor, Texas, May 13, 1929 (H. J. Reinhard).

## **Mylopharus canadensis** n. sp.

Very similar to the preceding species, but the parafacials much narrower as in *dorsalis*. From the latter it differs mainly as follows: scutellum reddish on apical margin; abdomen above with somewhat heavier and more yellowish to

almost golden pollen; female genitalia with a broader apical blade rather strongly bowed and truncate instead of rounded on the anterior apical extremity. Length, 6.5 mm.

*Holotype* male and *allotype* female, Bertheirville, Que., July, 1936 (L. Daviault), (ex. adults *Calligrapha bigsbyana*) in the Canadian National Collection. *Paratypes*: 1 pair, same data as type; 1 male, Marmora, Ont., July 25, 1942 (G. H. Hammond); and 1 male, Simcoe, Ont., June 14, 1938 (G. E. Shewell).

## **Trypheromyia** n. gen.

A smallish species with wholly yellow abdomen and pale-haired pleura. Allied to *Adoryphorophaga*, (genotype, *aberrans*), but the female abdomen acutely pointed, anal segment without differentiated row of discal or marginal bristles; genitalia not beaklike and entirely retracted.

Female only.—Head about one-fourth wider than high, frontal profile well sloped, subequal length of receding facial; antennal axis slightly below eye middle and nearly one-third longer than oral; epistoma short, broad, scarcely bowed forward from clypeus, latter moderately depressed; vibrissae on oral margin; facial ridges bearing two or three bristly hairs on lower extremity; parafacials bare, a little narrowed below and about two-fifths clypeal width; front at vertex 0.27 of head width, widening evenly downward into face; outer verticals shorter than straight inner pair; orbitals two, proclinate; frontals in a single row, two beneath base of antennae, upper two reclinate; ocellars proclinate, rather weak; antennae slightly shorter than face, first segment rather short, third barely three times length of second; arista moderately long, slender beyond basal fourth, micro-pubescent, proximal segments short; eyes thinly short-haired, not quite reaching to vibrissal level; cheeks one-fourth eye height; proboscis short, labella large, palpi strongly swollen beyond middle, with tips noticeably flattened above. Thoracic chaetotaxy: acrostichal 3, 3; dorsocentral 3, 3; intraalar 3; supraalar 3; notopleural 2; presutural 2; humeral 3; posthumeral 1; postalar 2; intrapostalar well developed; pteropleural 1 (small); sternopleural 1, 1; scutellum with 3 lateral, 1 discal and 1 decussate apical pair; prosternum finely haired on sides; propleura bare; infrascutellum strongly convex. Abdomen ovate, about as wide as thorax and a little longer than same; segments one and two with a pair of median marginals and third with a marginal row; intermediate segments with well developed discals and sometimes a smaller second pair; anal segment beset with bristly hairs above but without any differentiated discals or marginal row; sternites covered; genital orifice small and narrowed, caudoventral. Legs rather stout; hind tibiae subciliate; claws and pulvilli short. Wings reaching well beyond tip of abdomen; first vein bare, third with two or three small hairs near base; first posterior cell narrowly open shortly before extreme wing tip; hind cross vein nearer bend than small cross vein; last section of fifth vein short; costal spine vestigial.

Genotype: *Trypheromyia pallens* n. sp.

## **Trypheromyia pallens** n. sp.

*Female*. Head yellow in ground color with occiput darker or blackish above middle, pollen white to subsilvery on face and cheeks becoming more yellowish on parafrontals; latter with a few scattered short black hairs above middle outside frontal rows; frontal vitta rufous, equibroad but much narrower than parafrontal except at vertex; antennae yellow, third segment slightly infuscated, arista concolorous at base but darker or brownish beyond; cheeks and back of head wholly pale-haired; palpi also bearing a few fine pale hairs on lower side of thickened part.

Thorax blackish and gray pollinose above, with four narrow dorsal vittae, pleura almost entirely reddish yellow in ground color with thinner pale pollen;

scutellum reddish on apical margin; sides of postnotum beneath calypters bare; infrascutellum thinly pollinose on black ground color; prosternal vestiture white; calypters glassy white.

Abdomen yellow, dusted with changeable white pollen on last three segments above, which in most views appears divided on median line and extends thinly on venter; latter pale-haired on basal segments; hairs on upper surface depressed except longest ones on anal segment; genitalia wholly retracted.

Legs yellow, tarsi considerably darker or brown; mid tibia with one stout bristle on outer front side slightly below middle; three basal segments bearing some fine white hairs; middle coxae with ordinary bristles, no comb; fore tarsi normal.

Wings grayish hyaline; veins including costa pale yellow; fourth vein with an obtuse stumpless bend, thence nearly straight to costa; epaulets yellow.

Length, 6 - 6.5 mm.

*Holotype*: female, Amherst, Ohio, July, 1933 (H. J. Reinhard). *Paratype*: one female, labeled "Iowa, June 24, 1924."

## **Stenoneura** n. gen.

Differs from *Racodineura* in having the face much more deeply impressed, its ridges vertical and weakly bristled on lower third. Other differences are listed below.

Head about one-fourth wider than high, frontal profile nearly horizontal or but slightly sloped, much shorter than facial, latter strongly convex and moderately receding below; antennal axis high above eye middle, about three-fifths head height and much longer than vibrissal, which is very close to lower edge of head; clypeus broad, long and deeply sunk; epistoma short, as wide as clypeus and in plane of same; front and face equibroad, lateral ridges of latter subparallel; vibrissae on oral margin; parafacials bare, considerably narrowed downward; frontals in a single row, one or two bristles below antennal base; two proclinate orbitals in both sexes; inner verticals strong, reclinate, outer one small but distinct; ocellars proclinate and strongly divergent; antennae subequal length of face, basal segments short, third segment five or six (female) to eight or ten (male) times longer than second; arista close to base of third antennal segment, micro-pubescent, thickened on basal two-fifths, proximal segments short; eye bare, slightly oblique, not reaching to vibrissal level; cheek about one-fifth eye height; proboscis short, labella large; palpi short, spatulate. Thoracic chaetotaxy: acrostichal 1, 1 (none near suture); dorsocentral 3, 3; intraalar 3; supraalar 3; postalar 2; intrapostalar strong; presutural 2 (inner one small); posthumeral 1-2; humeral 3; notopleural 2; sternopleural 1, 1; pteropleural 1 (small); hypopleural 1-4; scutellum with 3 lateral (hindmost longest and divergent), 1 small discal and apical pair (latter not decussate and sometimes hairlike); prosternum, propleura and sides of postnotum beneath calypters bare; infrascutellum normally developed; calypters moderately large. Abdomen rather narrow in male, wider and more pointed apically in female, rather weakly bristled; first and second segments with pair of median marginals, third and fourth each with marginal row besides an irregular discal row on the last; intermediate segments bearing a pair of median discals: genital segments small, retracted; basal sternites covered, fourth narrowly exposed apically. Legs rather weakly bristled; hind tibiae not ciliate; claws and pulvilli short. Wings broad, reaching slightly beyond tip of abdomen; third with two or three hairs near base, fourth vein evanescent beyond bend, third reaching costa near wing tip; last section of fifth vein one-third length of preceding section; costal spine minute.

Genotype: *Stenoneura serotina* n. sp.

## **Stenoneura serotina** n. sp.

*Male.* Front at vertex 0.35 of head width and equibroad to antennal base; frontal vitta deep reddish brown, wider than parafrontal; latter with yel-

lowish gray pollen becoming subsilvery on parafacial; antennae wholly orange red, third segment much wider than parafacial, equibroad from base to tip, latter evenly rounded; arista reddish on thickened basal part thence darker, hardly equal length of third antennal segment; proboscis including labella pale reddish yellow; palpi concolorous, beset with short black hairs; back of head convex, gray pollinose, with sparse short pale hairs below middle.

Thorax and scutellum black, gray pollinose, notum with four narrow unbroken dark vittae which extend well behind suture but fade out before base of scutellum; calypters semitransparent, white.

Abdomen entirely gray pollinose above, first three segments black with a reddish tinge in ground color on basal margin of two and three and on venter, anal segment wholly red; genitalia concolorous; inner forceps rather short and thick in profile, separated by a V-shaped apical incision, each prong with a thin or sharp flange on outer side extending from base to tip; outer forceps much narrower and fingerlike, equal length of inner pair; fifth sternite red, rather narrowly divided apically, inner margin of lobes bare and shiny.

Legs red basally, tibiae brownish and tarsi nearly black; mid tibia with one small bristle well beyond middle on outer front side; tarsi stoutish, rather short; claws and pulvilli minute.

Wings uniformly gray hyaline; veins brown; epaulets dark reddish to black, subepaulets pale yellow.

*Female.* Front at vertex 0.38 of head width widening gradually to antennal base; frontal vitta narrower than parafrontal; antennae five-sixths length of face, third segment much smaller than in male and subequal parafacial width at middle; arista longer than third antennal segment; anal orifice long slitlike; genitalia retracted.

Length, 6.5 - 7 mm.

*Holotype* male and *allotype* female, College Station, Texas, April 21, 1943, and June 27, 1944 (H. J. Reinhard). *Paratypes*: 2 males and 1 female, same data as holotype.

## **Cloacina** n. gen.

Related to *Eleodiphaga,* but with the face less deeply impressed and not so strongly receding or bulged in profile; middle segments of arista elongate; abdomen without discals on intermediate segments.

Male only.—Head about one-third wider than high, nearly horizontal frontal profile a trifle over one-half facial, antennal axis close to upper margin of eye, about one-half head height and little longer than vibrissal, latter near lower edge of head; clypeus moderately depressed, long and equibroad; epistoma short, not narrowed from clypeus and gently bowed forward; vibrissae on oral margin, rather short, decussate at extreme tips; facial ridges ciliate to upper third; parafacial fully one-half clypeal width but slightly narrowed downward, sparsely setose to near lower extremity; front at vertex 0.42 of head width, increasing to 0.55 of same at antennal base and face, scarcely any wider downward to lower edge of eye; frontal rows converging from near vertex to mid front thence diverging forward, three bristles beneath antennal base; outer verticals developed, longer inner pair reclinate; ocellars strongly divaricate, moderately proclinate; antennae as long as face, first segment rather short, third very elongate, eight to ten times short second segment; arista bare, shorter than third antennal segment, thickened nearly to tip, middle segment fully one-third length of apical; eye bare, not reaching to vibrissal level; cheek nearly two-fifths eye height; proboscis short; palpi subequal length of haustellum, slightly thickened apically. Thoracic chaetotaxy: acrostichal 3, 3; dorsocentral 3, 4; intraaler 3; supraalar 3; presutural 2; posthumeral 2; humeral 3-4; notopleural 2; postalar 2; intrapostalar barely differentiated; sternopleural 2, 2; pteropleural 1 (not very strong); scutellum with 3 lateral, 1 smaller decussate apical and 1 discal pair; prosternum

bristled; propleura and sides of postnotum beneath calypters bare; infra-scutellum normal in size. Abdomen ovate, about as wide as thorax; first segment without differentiated median marginals, second with one pair, third and fourth with marginal row besides irregularly spaced discals on apical half above of last; hypopygium small retracted; sternites narrowly exposed apically. Legs rather stout; hind tibiae ciliated; claws and pulvilli short. Wings moderately broad at base, extending a little beyond apex of abdomen; first vein bare, third with three hairs near base; first posterior cell closed at costa to very short petiolate far before wing tip; hind cross vein slightly nearer bend, oblique and nearly in plane of apical cross vein; bend of fourth vein obtuse, far from hind margin of wing; last section of fifth vein about two-fifths length of preceding; costal spine small.

Genotype: *Cloacina filialis* n. sp.

## **Cloacina filialis** n. sp.

*Male.* Front broader than long, with thick gray pollen on sides extending downward on parafacials and cheeks; frontal vitta red, at middle much narrower than parafrontal, latter clothed with fine hairs and some stoutish bristles well outside main frontal rows; antennae wholly orange red, arista darker or brownish; cheek beset with short black hairs; palpi yellow; back of head pollinose, clothed with pale or whitish hairs.

Thorax and scutellum black, gray pollinose, notum marked with four dark vitta before and five behind suture, median one continuing on scutellum; calypters opaque white.

Abdomen black in ground color, gray pollinose on basal two-thirds or more of last three segments above, remainder of each including first segment subshiny black, venter with gray pollen extending to hind margin on all segments; hypopygium black; inner forceps short, divided, rather thick in profile and rounded on apex; fifth sternite black, retracted.

Legs black; hind tibia with one stout bristle in row of cilia on outer posterior side; mid tibia with two anterodorsal bristles; fore tarsi rather short and stoutish; claws and pulvilli hardly over one-half length of apical tarsal segment.

Wings whitish hyaline; veins including costa yellow; bend of fourth vein sometimes with a minute stump; epaulets black, subepaulets reddish.

Length, 8 mm.

*Holotype*: male, "Hartley Co., Texas, June 14, 1934." *Paratype*: 1 male, same data as type.

## **Nimioglossa** n. gen.

Allied to *Hypenomyia,* but parafacials bare, proboscis unusually slender, reaching nearly to mid venter.

Head as wide as high, long ventral profile at right angle to occipital, moderately sloped frontal about one-fourth longer than concave facial; oral axis a trifle longer than antennal, which is a little below eye middle; face but slightly impressed, its ridges bare, hardly diverging below; epistoma nearly full width, slightly prolonged in forward bow and shortly extended downward in membrane; vibrissae descussate, well above oral margin; parafacial equal clypeal width, not narrowed below; front strongly narrowed before ocellar triangle thence evenly widened downward into face; frontal rows extending from near mid front to base of antennae; inner verticals weak; outer pair vestigial; ocellars strongly proclinate; parallel; antennae three- fifths length of face, second segment nearly one-half third, bearing a long bristle near middle on front side; arista shorter than antenna, long plumose to tip; eye bare, reaching to or a trifle below vibrissal level; cheek one-third or more eye height; proboscis straight or slightly bowed forward, labella slender, divided; palpi subequal antennal length, slightly thickened at tips. Thoracic chaetotaxy: acrostichal 2, 2 (none near suture); dorsocentral 3, 3;

intraalar 2; supraalar 3; presutural 1 (outer); posthumeral 2; humeral 3; notopleural 2; postalar 2; intrapostalar not differentiated; pteropleural 1 (small); sternopleural 2, 1; scutellum with 2 lateral, 1 equally strong decussate apical and 1 small discal pair; prosternum and propleura bare; sides of postnotum beneath calypters setose; infrascutellum prominent; calypters large. Abdomen barely as wide as thorax but distinctly longer than same; first segment without second with a pair of long median marginal bristles, third bearing pair of stoutish discals and marginal row, fourth with a discal and a marginal row; sternites covered. Legs long, rather weakly bristled; hind tibiae not ciliate; tarsi slender, elongate; claws and pulvilli longer than last tarsal segment. Wings moderately broad and long; first vein bare, third with two or three small hairs near base; first posterior cell closed, petiole about one-third length of apical cross vein and reaching costa far before exact wing tip; bend of fourth vein obtuse, bearing a short stump, nearly one-half wing width from margin; hind cross vein oblique to fourth which it joins much nearer bend than small cross vein; latter far before apex of first vein; last section of fifth vein about one-third length of preceding; costal spine very strong.

Genotype: *Nimioglossa ravida* n. sp.

### **Nimioglossa ravida** n. sp.

*Male.* Front at vertex reduced to width of ocellar triangle and equal to 0.19 of maximum head width (average of two specimens); frontal vitta deep red, narrowed upwards to width of anterior ocellus but distinct to triangle; parafrontal, parafacial and cheek pale gray pollinose, the last above groove red in ground color; antennae red, apical half or more of third segment brownish to black; arista thickened on basal fourth, thence slender and yellowish to tip, proximal segments short; palpi reddish yellow; haustellum without any vestiture, shiny brown; back of head somewhat bulged at sides below, gray pollinose, sparsely clothed with coarse, black hairs above and fine pale ones below.

Thorax and scutellum black, gray pollinose, notum with four narrow poorly defined vittae, outer ones interrupted at suture and fading out well before base of scutellum; calypters opaque, white, hind lobe broader than long.

Abdomen wholly gray pollinose but venter more thinly so; hypopygium blackish, retracted, first segment thinly pollinose bearing a discal row of six bristly hairs; fifth sternite black, with a deep median incision, lobes large, prominent and contiguous on inner margin.

Legs black with a reddish tinge in ground color of trochanters and tibiae; mid tibia with one anterodorsal bristle.

Wings gray hyaline with a slight yellowish tinge basally; costal spine exceeding length of small cross vein; epaulets black.

Length, 8 - 9 mm.

*Holotype*: male, Lincoln Co., N. Mex., June 21, 1929, 9000 ft., (David G. Hall). *Paratypes*: 1 male, Jemez Springs, N. Mex., May 13, 1914 (J. Westgate); and 1 male, "South Creek, Beaver Co., Utah", in the Cornell University Collection.

### **Nimioglossa planicosta** n. sp.

Similar to preceding species but the costal spine minute or entirely lacking. Other differences may be listed as follows: male vertex 0.14 of head width; eyes at mid front separated by width of anterior ocellus, linear parafrontals contiguous and completely obscuring the frontal vitta, latter above antennal base subequal parafrontal width; cheek about one-fourth eye height; petiole of first posterior cell barely one-fourth length of apical cross vein.

Length, 7 - 8 mm.

*Holotype*: male, Trout Creek, Utah, May 7, 1934 (H. B. Stafford). *Paratype*: 1 male, "Riverdale, Utah, July 7, 1932".

# STUDIES IN THE CANTHARIDAE, II (COLEOPTERA)

BY KENNETH FENDER,
McMinnville, Oregon.

In 1866, Dr. J. L. LeConte* described *Podabrus fayi* and *Podabrus protensus.* He compared *P. fayi* and *Podabrus tomentosus* (Say), noting the differences but failing to indicate any similarity to *P. protensus.* *P. fayi* was cited as having black elytra whereas *P. protensus* was described as having a long tapering neck and with the elytra blackish with the basal fifth and the outer margin as far as the middle reddish yellow, the two colors shading imperceptibly together.

In 1881, Dr. LeConte† placed his *P. fayi* as a synonym of his *P. protensus.* This indicates the closer relationship to *P. protensus* than to *P. tomentosus* as originally noted. In so doing Dr. LeConte apparently concluded that the species with the black elytra was typical and the species with the bicolor elytra was a color form. In reality he relegated his *P. protensus* to the synonymy but retained the name and transferred it to his *P. fayi.*

In 1927, Dr. H. C. Fall‡, in his review of the genus, accepted LeConte's latter arrangement. Dr. Fall failed to give any synonymy for the species.

Genitalic studies show that two species are represented as Dr. LeConte originally noted. *Podabrus fayi* LeC. must be raised to its original status and the name *Podabrus protensus* LeC. will have to return to the species with the bicolored elytra. Brief descriptions of each species follow.

### **Podabrus fayi** LeC.

Yellow; elytra entirely purplish black, eyes and all but the basal segment of the antennae black, basal abdominal segments piceous, the apical two segments pale. Head shining, rather rapidly narrowed behind the eyes; finely sparsely punctate anteriorly, coarsely punctate behind the eyes; third antennal segment slightly longer than the second. The pronotum is shining, slightly wider than long. The anterior angles are rounded with the sides arcuately curved to the hind angles which are prominent. The pronotum is finely sparsely punctate, a little more coarsely punctate anteriorly. There is no eroded median line between the convexities which are low. The elytra are rugulose, the rugosity almost obliterating the elytral costae. The front tibiae of the male possess an apical process. All claws of both sexes are deeply toothed so that they appear to be broadly cleft. Length 9 to 11 mm.

Twelve specimens have been studied from Kentucky, Tennessee and Ohio.

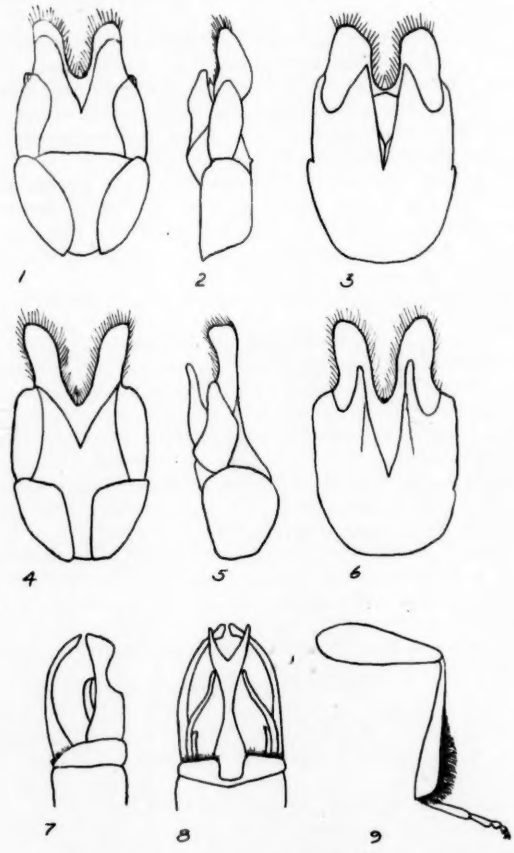
### **Podabrus protensus** LeC.

Yellow; elytra black, diffusely paler basally with the margins and suture pale as far as or farther than the middle. Basal antennal segment pale, the rest of the segments being piceous, narrowly annulated basally. Basal abdominal segments brownish with lateral margins pale. The last segment and the apical half of the penultimate segment of the abdomen are pale. The head shining, wider than the thorax in the male. The neck is long and gradually narrowed behind the eyes. The head is feebly sparsely punctate anteriorly, coarsely, more closely so behind the eyes. The pronotum is shining, narrowed anteriorly; the front angles are rounded and the sides arcuately widened to the hind angles which are prominent. The pronotum is feebly sparsely punctate being a little more coarsely punctured anteriorly. There is no eroded median line between the convexities which are low. The elytra are closely, coarsely punctured basally becoming rugose apically. There are three evident costae on each elytron. The front tibiae of the male are feebly bent and slightly dilated apically. The hind coxae possess apical processes. All claws of both sexes are deeply toothed so that they appear to be broadly cleft. Length, 10 to 12 mm.

*LeConte, J. L., Smiths. Misc. Coll. VI, no. 167, 2nd. Ed., p. 91.
†LeConte, J. L., Trans. Am. Ent. Soc., IX, 1881, pp. 47 & 69.
‡Fall, H. C., Ent. Am., VIII, no. 2, 1928, p. 83.

Ten specimens have been examined from Georgia, Tennessee, Pennsylvania and New York.

These two species may be separated immediately by their differences in elytral coloration. The hind angles of the pronotum of *Podabrus fayi* are more prominent than are those of *Podabrus protensus.* The neck of *P. protensus* is a little longer and more tapered than is that of *P. fayi.* Aside from these characteristics the two species are quite similar externally.




Figures 1, 2 & 3, dorsal, lateral and ventral views, respectively, of male genital armature of *Podabrus protensus* LeC.; 4, 5 & 6, dorsal lateral and ventral views, respectively, of male genital armature of *Podabrus fayi* LeC.; 7 & 8, lateral and ventral views, respectively, of last abdominal segments of *Malthodes hirsutotibialis* sp. nov.; 9, lateral view of hind leg of *M. hirsutotibialis* sp. nov.

## **Malthodes hirsutotibialis** sp. nov.

Head black, front pale, head slightly wider than the thorax, finely punctate. Basal segment of antennae pale, the following four segments darkening progressively to piceous, the apical segments piceous. Pronotum pale, shining, finely punctate, the anterior angles obliquely truncate, the sides sinuately narrowed to the hind angles which are feebly prominent. All of the margins

are narrowly reflexed. The elytra are piceous with the apical fifth paler, shining, finely sparsely punctate and finely pubescent. The femora and basal half of the prolegs are pale, the tarsi and apical half of prolegs dusky. The middle and hind legs are piceous. The tibiae of the hind legs are apically dilated and apically grooved on the posterior face, the sides of the groove being adorned with long pale silky hairs. Length, 4 mm.

Male sexual characters: The last ventral is produced, being rather wide basally, narrowing medially then widening and becoming strongly furcate apically, the tines of the furcation being widely divergent. In profile the seventh ventral is curved. The sides of the last dorsal are apically produced, extending to the rear and converging until the tips nearly meet. A secondary pair of hooks arise just inside the side pieces and project backward and sinuately inward, extending nearly to the apical third of the side pieces. A third pair of processes lie just inside the secondary set. They are short and fairly straight with the apices beveled outwardly.

*Holotype,* male, Black Mountain, N. C., July 10, 1940, collected by J. W. Green. This species can be readily separated from any other known species of the genus by its dilated, grooved and hirsute hind tibiae.

## BOOK NOTICE

Entomology for Introductory Courses, by Robert Matheson, Professor of Entomology. Ithaca, N. Y., Comstock Publishing Co., 1944. Price $5.50.

When I visited Cornell University in 1943, Dr. Matheson showed me proof pages of this very useful publication of 600 pages with 500 illustrations. In addition to the 23 chapters there is a rather full glossary and bibliography. The book "has been planned for the use of the student who is beginning a study of insects". Throughout its pages, the emphasis has been placed upon the biology, habits, and habitats of the common insects, and particular attention has been given to the part they play in agriculture and industry. In addition to chapters entitled "The Phylum Arthropoda", "The Class Hexapoda or Insects", "The Mouthparts of Insects", "Development and Growth in Insects", "Classification of Insects", there are several in which "Insects in Relation to Human Welfare" are discussed.

The writer has been impressed with the amount of material which has been brought together in this volume, especially on the biology and habits of representative species in the various orders and families. I like too the presentation of useful information in the chapters on "Insects in Relation to Human Welfare".

In the bibliography, although the publications of the U. S. Bureau of Entomology and Plant Quarantine are referred to, no mention is made of similar publications which have been issued by the Canadian entomological service. We are pleased to note, however, that the author has used a number of our illustrations. The legend under figure 428 should read "After Hadwen" not "After Hawden".

Dr. Matheson is to be congratulated on the results of his labours. As a teacher of many years, he knows what the students need. The book should have a ready sale.

Arthur Gibson

## A NOTE ON THE SWARMING OF *SOLENOPSIS MOLESTA* SAY (HYMENOPTERA)

One calm warm evening towards the end of August, 1942, as I was walking on the bank of the Madawaska River near Arnprior, Ontario, where the stream is bordered by a large treeless pasture, I noticed two or three small clouds of insects dancing like midges a few feet above the ground. The swarms were dense, and were from four to six feet high and three to four feet in diameter; their lowest point was about three feet from the ground. The movements of the insects were relatively sluggish as compared with the lively dancing of midges and other flies.

I walked through one of the swarms to see what would happen, and noticed that it did not disperse but that many of the insects lit on me. Then I saw that they were small yellow ants, obviously females on their nuptial flight. Not being particularly interested in ants, I was looking with mild curiosity at the score or so that were walking on my sleeve, when among the winged individuals I saw a very small wingless one that must have dropped from one of the fliers. This seemed remarkable, and for further investigation I picked up the wingless one and six of the fliers in a vial. When I got home I killed them in the bottle and set them aside for the time being. A few days later I emptied the contents of the vial into a watch glass for examination, and found that in addition to the wingless one and the six fliers, there were two more wingless individuals that must have been carried unnoticed by the fliers when I collected them. The Division of Entomology at Ottawa, to whom I sent the specimens, identified them as the thief ant, *Solenopsis molesta* Say, the winged forms being young queens on their nuptial flight and the wingless ones workers.

The Division also searched the literature for mention of *Solenopsis* queens carrying workers on their nuptial flight, but found none. Although *S. molesta* is one of the commonest of North American ants, very little has been published about it, and practically nothing of its swarming habits. Apparently large flights of the ant are rare. But it is well known that queens of the African thief ant, *Carebara,* rather closely allied to *Solenopsis,* habitually carry minute workers with them on their nuptial flight to help in founding new nests in the termitaria which this ant infests. This suggests not a *probability* but a *possibility* that the allied *Solenopsis* might practise a similar habit, or perhaps an incipient form of it.

The total number of queens in the swarms I observed might run into the tens of thousands, and if the six queens I collected could be regarded as a fair sample, every third queen in the flight was carrying a worker. But our data are far too meagre to warrant any such startling conclusion. On the other hand it would seem extremely improbable that I chanced on the only queens in all the vast concourse that were carrying workers. And it is not unreasonable to assume that others also had their worker freight, though impossible to say how many; and the principal object of this note is to suggest to entomologists who encounter the rare *Solenopsis* swarm that they should examine it for queens bearing workers. The insects are easy to collect (I shall never cease to regret that I did not take a hundred specimens instead of a miserable six); and if it is found to be a regular practice, some myrmecologist may be induced to discover how it fits into the ant's life history, and if it has any relation to nest finding.

Charles Macnamara,
**Arnprior, Ontario.**

Mailed Friday, May 11, 1945.

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